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The Effect of a Speech-Generating iPad Application on the Communication Outcomes of Students Who Have Complex Communication Needs in Educational Settings: Three Case Studies

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The Effect of a Speech-Generating iPad Application on the Communication Outcomes of Students Who Have Complex Communication Needs in Educational Settings: Three Case Studies

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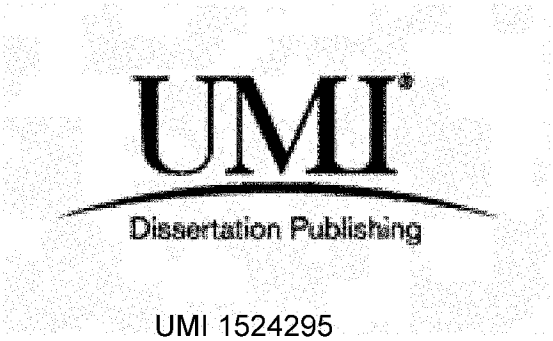

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DEDICATION

For all children who cannot speak for themselves.

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ABSTRACT

THE EFFECT OF A SPEECH-GENERATING IPAD APPLICATION ON THE COMMUNICATION OUTCOMES OF STUDENTS WHO HAVE COMPLEX COMMUNICATION NEEDS IN EDUCATIONAL SETTINGS: THREE CASE STUDIES

by

Amber Szilagyi

University of New Hampshire, September, 2013

The purpose of this pilot study was to investigate the efficacy of the use of a speech-generating application on the Apple iPad as a speech-generating device (SGD) by measuring three students' progress towards individual communication goals using the *Speak for Yourself! (SFY)* speech-generating app. The proposed speech-generating device was implemented into regularly scheduled speech-language therapy sessions with 3 students with complex communication needs (CCNs) over a 12-week period. Data measured at three different points were collected by students' speech-language pathologists using Goal Attainment Scaling. Results were positive. All student participants made progress towards, reached, or exceeded communication goals during the of 12-week period when using *SFY* in regularly scheduled speech-language therapy. This suggests that school-aged students with CCNs can benefit from the use of an iPad as a SGD.

Introduction

> The silence of speechlessness is never golden. We all need to communicate and connect with each other—not just in one way, but also in as many ways as possible. It is a basic human need, a basic human right. And much more than this, it is a basic human power. (Williams, 2000, p. 248)

Living life without the ability to speak or be understood, to establish social closeness with family, or to make friends through shared experiences is a form of seclusion that is the reality for approximately 1.3% or nearly four million Americans. This population has such significant communication disabilities that they cannot depend on the production of their natural speech to meet the needs of daily communication (Beukelman & Mirenda, 2013, p. 4). Topia and Hocking (2012) described the ability to communicate as a fundamental importance to psychosocial adjustment in society. Therefore, communication difficulties may result in social isolation and challenges with interpersonal relationships. Without the ability to communicate using natural speech, individuals can be left restricted in their participation and inclusion in many integral aspects of life including education, family, and community.

Augmentative and Alternative Communication

Those who have difficulty utilizing oral speech skills required to communicate are referred to as having "complex communication needs" (CCNs)[1]

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[1] For the purpose of this research, the term "complex communication needs" will be used when referring to individuals who have difficulties with speech who may require an alternate method of expressing their needs and wants.

(Beukelman & Mirenda, 2013, p. 4). Individuals with CCNs often benefit from the use of augmentative and alternative means of communication (AAC). The American Speech-Language-Hearing Association (ASHA), defines AAC as:

> ...an integrated group of components, including the symbols, aids, strategies, and techniques used by individuals with severe speech and language disabilities to enhance communication. The system serves to supplement any gestural, spoken, and/or written communication abilities. Augmentative and alternative modes of communication have assumed an increasingly important role in meeting the communication needs of individuals with severe disabilities (p. 1) (2008).

Quality of life and communication options for those with CCNs have changed greatly over the last 40 years. In the past, people with CCNs typically lived in state institutions where they were isolated from the community (Collier, McGhie-Richmond, & Self, 2010; Mirenda, 1993). It was unusual to see an individual with CCNs using AAC interventions as these strategies were only permitted for use with those who were considered to meet certain "prerequisite" skills outlined in a matrix for decision making (Shane & Bashir, 1980). Since that time, there have been significant shifts in AAC practices that can be attributed to a growing evidence base documenting positive outcomes of AAC intervention (Light & McNaughton, 2012).

An AAC system is not synonymous with the device or technology used by an individual with CCNs, but rather refers to a broad, integrated group of

strategies, symbols, tools, and techniques from which an individual with CCNs may choose when communicating anywhere, anytime, and with anyone (Blackstone, Williams, & Wilkins, 2007). ASHA (2005) defines an AAC system as having four components (symbols, aids, techniques, and/or strategies) that are incorporated to enhance an individual's communication.

There are numerous forms of AAC technology aids. Technology used in an AAC system can range from "low-tech" aids like the Picture Exchange Communication System (PECS) (Bondy & Frost, 2001) to "high-tech" SGDs (Beukelman & Mirenda, 2013). Individuals using AAC may utilize a variety of aids as part of their AAC system, including: communication books, communication boards, charts, mechanical or electronic devices including those that speak, and computers (Reichle, Beukelman, & Light, 2002). There are multiple factors to consider when deciding which type of communication aid is best for an individual with CCNs including: features of the AAC technology; the individual's motor, sensory, and perceptual abilities; cognitive and linguistic skills; and the device users and their communication partners' abilities to interact and communicate (Beukelman & Mirenda, 2013; Higginbotham et al., 2007).

The overall goal of the implementation of an AAC system is to increase and make more efficient the user's level of participation, inclusion, and use of varied communicative functions. According to Mirenda (2003), AAC systems should result in generalized, functional communication in natural contexts over the long term. The term "functional" in this case refers to an individual's use of an

AAC system in a generalized manner—across settings and communicative partners over an extended period of time (Mirenda, 2003).

The evolving field of AAC offers new possibilities for communication and interaction for those with CCNs. Light & McNaughton (2012) attributed these new and increased opportunities in AAC to changes that have occurred in the demographics of the population of individuals who require AAC, growing interest in and availability of AAC technologies, and a growing evidence base. For example, the increased prevalence of autism spectrum disorders (ASD) to 1 in 88 (ADDM, 2012) is one of the primary reasons the number of individuals who require AAC has increased (Beukelman, 2012), as 30-50% of children with ASD do not develop functional speech and would benefit from AAC (National Research Council, 2001). AAC technologies are being introduced to a wider variety of users, including young children who are at risk for delays in speech-language development or have decreased intelligibility of speech, such as those who have developmental disabilities (DDs).

In addition to the increase in the numbers of people who require AAC, there has been an increase in the cultural and linguistic diversity among individuals who use AAC (Binger, Kent- Walsh, Berens, Del Campo, & Rivera, 2008). As of 2010, the U.S. Department of Education reported 40-45% of all children served through the Individuals with Disabilities Education Act (IDEA) come from culturally and linguistically diverse families (Light & McNaughton, 2012).

The technology used as part of AAC systems is constantly evolving. A speech-generating device (SGD) is a portable electronic device that will produce previously recorded or digitized speech when activated by the individual intending to communicate. Generated messages are intended to provide the user with the ability to use a broad range of communicative functions such as requesting, commenting, greeting or answering questions (Schlosser, 2003).

SGDs may vary in terms of the type of display (e.g., static or dynamic), the number of communicative options presented, the types or presence of symbols used, the use of digitized or pre-recorded speech, as well as the shape, size, and price of the device (Mirenda, 2003; Lancioni et al., 2007; Schlosser, 2003). Achmadi et al. (2012), described contemporary SGDs (such as DynaVox or Prentke Romich Company devices) as typically consisting of a computer-based, speech-synthesizing unit and visual display. Visual displays are usually configured with a number of icons (e.g., colored line drawings) representing words or phrases. Touching the icons produces corresponding speech output.

A variety of SGDs have been available for many years. Manufacturers produce and regularly upgrade these devices and provide training to users of the device and those who will teach the user how to communicate using the device. Though expensive (pricing can range from $5000-$10,000 and higher), these devices are quite popular in educational settings. This type of AAC aid is used by a variety of AAC users, including children with DDs (Mirenda, 2001; Mirenda; 2003; Mirenda, Wilk, & Carson, 2000).

The increased professional and public awareness of AAC are related to positive outcomes of AAC intervention highlighted by a growing evidence base (Light and McNaughton, 2012). As an area of practice, AAC has a continuously growing evidence base that demonstrates the effectiveness of AAC technologies and strategies across a widely diverse spectrum of individuals with CCNs who differ in age, disability, socio-economic status, culture, language, and beyond. The evidence base for the area of AAC has been accumulating over the last three to four decades, with research supporting its use across the lifespan (Blackstone et al., 2007; Schlosser & Raghavendra, 2004) and is ever expanding.

Schlosser and Raghavendra (2004) discussed the relevance of evidence-based practice (EBP) to the field of AAC. These researchers offered a decision-making process and a working definition of EBP as it relates to AAC: "Evidence-based AAC practice is the integration of best and current research evidence with clinical/educational expertise and relevant stakeholder perspectives, in order to facilitate decisions about assessment and intervention that are deemed effective and efficient for a given direct stakeholder" (Schlosser and Raghavendra, 2004, p. 3). Schlosser and Raghavendra (2004) also illustrated a schematic of the EBP process as it relates to AAC. This schematic serves as a guide for those who want to use EBP effectively by highlighting the key steps of this process: (a) develop a "well-built" question, (b) perform a data search for evidence using valid sources, and (c) then implement the identified strategy in a clinical manner. After implementation, the clinician must decide if the EBP was successful and then

disseminate the experiences. The only way EBP works successfully is through the sharing of information via professional conferences, journals, and/or newsletters. This way, other professionals may benefit from its implementation.

Speech-Generating Devices and Children with Developmental Disabilities

Children with DDs, including ASD, Down syndrome, and severe speech-language delay, often present with difficulties in communication, understanding language, development of social skills, and relating to others (Rispoli et al., 2010; Schlosser & Sigafoos, 2004). AAC interventions have been shown to improve both social and communication skills in children and youth with DDs (Beukelman & Mirenda, 2013; Schlosser & Sigafoos, 2004; van der Meer, Didden, et al., 2012; van der Meer, Kagohara, et al., 2012; van der Meer). The use of AAC has become an essential part of language intervention programs for many children with DDs who experience significant difficulties with communication and social skills (Mirenda, 2003).

Mirenda et al. (2000) studied the use of SGDs by 58 students with DD, including ASD, who ranged in age from 5 to 17 years old over a five-year period. Before the study began, 41% of the students had no functional speech, 50% had limited speech, and the remaining 9% had an inadequate level of functional speech to meet their daily needs. Outcome data based on the use of SGDs were analyzed and assigned success scores of "little to no success", "limited or some success", or "very successful". Results showed 8 students had little or no success with a SGD, 19 students had limited or some success, and 31 students (55%) were successful or very successful. The 31 students who were rated as

successful or very successful with a SGD represented all levels of cognitive ability (average ability = 26%, mild delay = 16%, moderate delay = 35%, and severe delay = 23%). This study suggested that many students with DDs, including those with ASD, could successfully use SGDs.

Van der Meer, Sutherland, et al. (2012) compared acquisition, maintenance, and preference for three AAC modes among four children with DDs (ASD, Childhood Disintegrative Disorder, and Angelman syndrome). Based on a previous review of literature, the investigators hypothesized that the four children would show a preference for using one AAC mode over two other choices and that the children would learn forms of functional communication (e.g., making requests) more quickly when using their preferred communication mode. Children were taught to make general requests for preferred items (snacks or play) using a SGD, picture-exchange, and manual signs. The effects of intervention were evaluated using a multiple-probe across participants and alternating-treatments design. During the intervention period, all four children learned to request using picture exchange and the SGD, but only two also reached criteria with manual signs. Preference probes were also conducted to determine if children would choose a form of AAC more frequently than the others. Three of the four participants chose the SGD more frequently and one participant appeared to prefer using picture exchange.

Schlosser and Sigafoos (2006) performed a narrative review of comparative single-subject experimental studies, describing the studies in terms of their methodological adequacy and implications for further research and

practice. The researchers divided their findings into three groups: aided approaches, unaided approaches, or a combination of both. To be included in this narrative review a study had to compare at least two types of AAC and participants had to have been diagnosed with DDs. Of the total number of studies reviewed, twenty studies focused on the use of aided systems. Of these twenty, three studies compared the use of a non-electronic communication board and SGDs. Though results of these studies suggested users showed a preference for the SGD, methodological weaknesses deemed results inconclusive. This information supports the continued need for research regarding the use of SGDs with individuals with DDs.

A literature review compiled and synthesized by Rispoli et al. (2010) identified a total of 35 studies that explored the use of SGDs with individuals with DDs. To be included in this review, the article had to describe a research study that included the provision of a communication intervention using a SGD with at least one person with a diagnosis of a DD other than ASD. Each of the studies was evaluated in regards to participants, SGD function, SGD characteristics, intervention procedures, intervention results, and certainty of evidence. The majority of the studies measured making requests for preferred foods, toys, and social communication. Of the 35 studies reviewed, 86% of them reported positive outcomes. Thirteen of the studies reporting positive outcomes explored the use of SGDs with children in the 4-12 year age range with DDs who have CCNs. Of those 13, all showed an increase in the use of SGDs for communication given intervention/training for requesting, increased social interaction, negation, and in

one case, a decrease in challenging behaviors. However, according to Rispoli and colleagues, evidence from all studies reviewed should be "interpreted with caution" (2010) because although positive, these outcomes were considered inconclusive in terms of certainty of evidence given the small number of participants in the studies. According to the researchers, the use of SGDs to improve communication in individuals with DDs can best be described as a promising practice—meaning it is potentially effective, yet requires additional empirical investigation.

iPods/iPads as Speech-Generating Devices

A challenge for clinicians with clients who would benefit from the use of a SGD is keeping up with new technology, as the rate of release of new technology is much higher compared to the rate of the release of systematic analysis. The newest example of this comes from the Apple iPad's introduction of the iPod/iPad technologies and corresponding speech generating applications.

The world of technology shifted with the release of the first iPad in April 2010. Apple, Inc. was given rave reviews for creating a sleek, lightweight, multi-purpose, high-tech device with the potential to redefine the personal computer (Baker, 2012; Griffey, 2012; Hager, 2012; Murray & Olcese, 2011, Price, 2011). Since then, the use of tablets, such as the iPad, has reached the domains of education, special education, and specialized services such as speech-language pathology. Thousands of applications (commonly referred to as "apps") have been released—30,000 have been produced under the category of "education" since June 2010 (Murray & Olcese, 2011).

Apple Inc.'s iPad and other tablet devices have provided yet another medium for AAC—particularly speech-generating technology (Hager, 2012). The iPad is more affordable than most SGDs; it is smaller and lighter, and carries a different social connotation than traditional technology.

Preliminary exploration of speech-generating apps on the iPad has attracted media attention, such as a segment on *60 Minutes* (Stahl & Sughrue, 2011) and other news programs promoting success of their use. For example, in an ABC News story from April 2010, Sharyn Alfonsi interviewed Sam Sennott (co-creator of *Proloquo2Go*™) who claimed that the app could help give those with ASD a voice (ABC News, 2010). This particular video has been viewed over 50,000 times on YouTube.

As a result of publicity and positive anecdotal reports (Baker, 2012; Hager, 2012; Murray & Olcese, 2011, Seeton, 2009) and because of the iPad's increased portability, relative affordability, peer acceptance, and convenience (Sennott & Bowker, 2009), there has been a great interest among parents, educators, and direct service personnel in school systems throughout the United States (Murray & Olcese, 2011). Schools began purchasing this user-friendly device for teachers in the hopes of increasing technology use within classrooms. Direct service providers, such as speech-language pathologists (SLPs) and occupational therapists (OTs) began using iPad technology during therapy sessions with students as well.

Sheldon (2012) noted of the thousands of education related apps, more than 50 apps had been created for use on the iPad as AAC or speech-

generation. This number continues to grow. A recent personal search (April 2013), yielded the existence of over 300 apps currently available under "AAC", many of which claim that they can turn the iPad into a multitasking SGD. However, professionals are left with some questions: Does scientific evidence exist supporting the use of the iPad as a SGD? Can children with CCNs who would benefit from AAC make gains towards communication goals as defined in their Individualized Education Plans using an iPad as a SGD?

Preliminary research is beginning to emerge regarding the efficacy of using the iPod/iPad as a SGD. For example, researchers found the use of the iPad as a SGD using the application *Proloquo2Go*™ increased requesting skills of individuals with ASD (Sennott & Bowker, 2009).

Kagohara and colleagues (2012) conducted a systematic review of eight studies regarding the use of iPods and iPads in teaching programs for individuals with DDs to improve communication. Seven out of the eight studies reviewed measured communication based on the participants' use of iPod-based speech generation to request snacks or preferred stimuli and the eighth study had participants label educationally relevant pictures. Seven out of the eight studies used an Apple-based operating system in the form of an iPod touch paired with the *Proloquo2Go*™ speech-generating app. All participants in these studies were school-aged with the exception of one 23-year-old and were diagnosed with DDs.

The first study, by Kagohara et al. (2010), focused on teaching a 17-year-old with DD to request snacks using the *Proloquo2Go*™ app. Initial data showed the participant was able to locate the icon for the desired item, but struggled to

press the icon to produce speech output on the device. Performance increased from 30-100% once a 10-second delay procedure was introduced, suggesting differential reinforcement and delayed prompting were effective in shaping the participant's response topography which allowed him to successfully use the app.

Van der Meer et al. (2011) used the *Proloquo2Go*™ app to teach three individuals with DDs to request snacks and toys. Using a multiple probe across participants design, researchers showed that two participants learned how to use the app to make requests; one participant did not make any progress within 40 training sessions. Similar to Kagohara et al. (2010), this study showed successful use of physical prompting and differential reinforcement for teaching two of three participants to use an iPod-based SGD to make requests.

More steps to operating the device were added to a similar design by Achmadi et al. 2012. The device was programmed to support requests for preferred stimuli. Two participants were taught additional steps for general operation of the iPod: turning it on, unlocking the screen, and navigating to the correct page. Both participants learned to perform these more advanced operational steps for using an iPod based system. This was an important addition to the procedure as it shows the potential for users to become more independent in their use of these devices.

Flores et al. (2012) compared an iPad-based system to a picture-based communication system. Five participants diagnosed with DDs and who had previous experience using a picture card system, participated in the study. In contrast with the previously described studies, participants practiced using the

app *Pic a Word* by Read Mountain Labs, Inc. until they used the app to request snacks independently. The results of this study suggest the participants performed better with the iPad system than the picture-based system, as three participants made more requests using the iPad system while two showed no difference in the number of requests made with either system.

Kagohara and van der Meer collaborated with other researchers in a two-part study aiming to teach two participants to name educationally relevant pictures (Kagohara, van der Meer et al., 2012). Both participants had prior experience using the iPod-based system as they participated in two of the researcher's previous projects. A multiple-probe across participants design, involving baseline and intervention phases, was used to evaluate the effects of the intervention. In the first part of study, participants were asked to label a single photograph following the prompt "What do you see?" and then to label a picture being pointed to on a page with three others in response to "What is this?" In the second part of the study, the same participants were presented with 18 pictures from a children's book. Six photographs from each of three categories (body parts, foods, and household items) were presented for the students to name by selecting corresponding, but not identical, icons from the iPad. The procedures were similar to the first study. With intervention, which consisted of "least-to-most" prompting, accuracy levels ranged from 58-100% across both participants in both studies. These findings suggest that individuals with DDs can successfully engage in a picture-naming task using an iPad-based SGD.

Three additional studies that aimed to teach participants to request preferred stimuli by using the *Proloquo2Go*™ app on an iPad were published in 2012 (van der Meer, Kagohara, et al., 2012; van der Meer, Didden et al., 2012; van der Meer). As a group, these three studies provide evidence that generally well-established discrete-trial instructional procedures were successful in teaching individuals diagnosed with DDs and CCNs to use an iPod Touch or iPad as a SGD to make requests for preferred items. Touching icons on the screen activated corresponding synthetic speech output via the *Proloquo2Go*™ app. All three studies employed a multiple baseline across participants design to measure the effects of teaching procedures and an alternating treatments design to compare use of the two or three communication methods. In addition, the studies included assessments to determine if students had a preference for mode of communication. The discrete-trial training procedures involved offering preferred items, verbal cueing, time-delay, graduated guidance, and differential reinforcement.

Three of the four participants in each of these studies showed a preference for use of the iPod Touch or iPad as a SGD over manual signs (van der Meer, Kagohara, et al., 2012) and over manual signs and picture exchange (van der Meer, Didden, et al., 2012; van der Meer, Sutherland, et al., 2012). Additionally, van der Meer, Sutherland, et al. (2012) found the participants showed better maintenance of their enhanced requesting skills with their preferred system.

Making the Case

Due to an increase in use of mobile technology, device acquisition and AAC system development no longer rely on the traditional assistive technology manufacturers (Rummel-Hudson, 2011). Anyone can make an app that can be used with a tablet device. Many apps are sold at very low or at no cost. This means that the number of choices for consumers and educators has exponentially increased. However, many AAC apps are not based on research evidence, as they often are not developed by those who possess the expertise. Often, consumers and educators are left without the benefits that many other forms of AAC can provide as they are not appropriately designed to meet individual communication needs and/or do not come with sufficient technical and implementation support (RERC on Communication Enhancement, 2011).

Results of the reviewed iPod/iPad studies generally have been positive, providing emerging evidence supporting the use of the iPad as a SGD. Most of the research to date has focused on the use of one particular app (i.e., *Proloquo2Go*™). Most of the research primarily has focused on use of the iPod/iPad for requesting and labeling. Research has not focused on the demonstration of functional communication or use directly related to the participants' individual goals for language competency. The use of these devices for other communicative purposes (e.g., greeting, conversation, commenting) or uses that were specific to the participant's needs would be important directions for future research.

There is a continuing need for research that will effectively document new techniques, aids, and interventions in the field of AAC as EBP plays a fundamental role in clinical decision-making. It is important in this field especially, as new technology is developed at an increasingly rapid rate and the population of those using these technologies is widening (Beukelman, 2012).

The Current Study

The primary purpose of this pilot study was to investigate the efficacy of the use of a speech-generating application on the Apple iPad as a speech-generating device (SGD) by measuring three students' progress towards individual communication goals. This pilot study aimed to answer the following questions:

- Can elementary-aged students with CCNs use an iPad as a SGD?
- Can elementary-aged students with CCNs make gains towards communication goals as defined in their Individualized Education Plans (IEP) by using a speech-generating app on an iPad as a SGD?

Given the evidence base supporting the use of traditional SGDs and the emerging evidence base supporting the use of iPad technology, the aim of this study is to determine if gains in specific communication goals can be measured in three elementary-aged children with CCNs using an iPad as a SGD in school-based speech-language therapy. It was hypothesized that students would make progress towards specific communication goals when using a speech-generating app over time.

Methods

The research design and subsequent procedures were approved by the Institutional Review Board of the University of New Hampshire. This research involved a series of three case studies to assess change over time on multiple variables aligned with each student's individualized communication goals for therapy.

Participants

The pool of participants for this series of pilot case studies included three elementary-aged students between the ages of 5 and 9 who presented with CCNs. Each student had a different communication disorder that affected his or her use of natural speech for effective communication and therefore met the criteria for CCNs. The presenting disabilities among the students were: (1) Autism Spectrum Disorder (ASD), (2) Down syndrome, and (3) severe speech-language delay. Each student was considered to potentially benefit from speech-generating technology based on the clinical judgment of his or her school-based SLP. Each student's SLP had received specific training on use of the iPad with a speech-generating app and participated in a study regarding the outcomes of such training (see Hall, 2013 for details).

Each student was assigned a pseudonym for the purposes of this research. An overview of the students' characteristics can be found in Table 1. Descriptions are provided regarding each student's educational skills, including the results of available standardized testing, based on a review of the student's educational records and interviews with the student's school-based SLP.

Table 1

Overview of Students' Characteristics

Characteristics	"Michael[a]"	"Elsa"	"David"
Age	8	9	4
Grade	3	4	K-full day
Diagnosis	Down syndrome	Autism Spectrum Disorder	Severe Speech Language Delay
Prior use of AAC	manual signs, PECS[b]	PECS	no
Educational Model	inclusion	inclusion	inclusion
Presence of Paraprofessional	yes	yes	no

Note: [a]Names of the students are pseudonyms

[b]PECS: Picture Exchange Communication System

Michael. Michael was 8 years of age and attended a general education 3rd grade classroom at the time of the study. He had a diagnosis of Down syndrome. He previously had been introduced to manual signs and PECS (Bondy & Frost, 2001).

Educational skills. Michael was performing below age/grade level educational expectations. He demonstrated significant global developmental delays across all domains, which impacted his learning and his ability to demonstrate his level of skill. Michael's most recent educational evaluation had occurred 2.5 years prior to his participating in the study. These data were considered outdated regarding his current abilities for use in his participant profile for the purposes of this study. According to his SLP, the team was unable to assess his IQ at that time. In order to access the academic curriculum and safely

access the school environment, David required one-on-one assistance from a paraprofessional throughout the school day. Limited motor skills impacted his ability to complete fine and gross motor tasks in and out of the classroom with his peers.

Functional communication skills. Verbal communication was considered a significant area of weakness and Michael was considered a "primarily non-verbal" communicator by his SLP. Although he could use some verbalizations to imitate sounds and approximate some words, natural speech was not deemed an effective mode of communication. Prior to the beginning of the study, Michael's primary mode of communication was manual sign. His team had begun the process of assessing Michael's candidacy for an AAC voice output device.

Elsa. Elsa was 9 years of age and attended a general education 4th grade classroom at the time of the study. She had a diagnosis of Autism Spectrum Disorder. She previously had been introduced to PECS (Bondy & Frost, 2001).

Educational skills. Elsa experienced interfering behaviors that limited her availability to participate in the educational activities throughout the day. She was supported by a paraprofessional in the classroom. A lack of adequate communication skills limited her ability to easily or independently access the academic curriculum. Standardized instruments were not used in previous evaluations due to her limited ability to respond to formal test measures and low cognitive functioning.

Functional communication skills. Elsa was described by her SLP as an

"essentially non-verbal communicator". She was able to understand many common single vocabulary words (nouns and some verbs) and could label objects and pictures by pointing to or giving the object once the expectation was established. She could follow simple verbal commands given a visual prompt. Expressively, Elsa could use PECS independently for highly desired items by producing a message of 4-6 words including modifiers. However, it was noted that these instances did not occur often. She was able to verbalize some single words to label only using an expected language structure and given a model.

David. David was 4 years of age and attended a general education full-day kindergarten classroom at the time of the study. He had a diagnosis of severe speech and language delay. He previously had not been introduced AAC strategies.

Educational skills. David's educational performance was greatly impacted by a diminished level of speech intelligibility for both familiar and unfamiliar listeners. He also presented with under-developed math and reading readiness skills. Visual perception skills were considered to be an area of strength. David also presented with slightly delayed motor skills.

David had undergone a comprehensive educational evaluation prior to participating in this study. The results of administered standardized assessments included the following:

- Young Children's Achievement Test (YCAT): Below 5th percentile for General, Reading, Writing, and Spoken Language measurements.

Functional communication skills. David presented with significant speech-language delays. His misarticulations and syntactical errors impacted his ability to communicate. The results of previously administered standardized communication assessments included the following:

- Peabody Picture Vocabulary Test 4th Ed. (PPVT): 3rd percentile
- Expressive One Word Picture Vocabulary Test-4th Ed. (EOWPVT): 1st percentile
- Clinical Evaluation of Language Fundamentals Preschool-2(CELF P-2): Significantly below average on all subtests besides Word Classes-Expressive
- Goldman Fristoe Test of Articulation 2 (GFTA-2): 2nd Percentile (significantly below age expectations)

Recruitment. The three school-based SLPs recruited for the study on the impact of specific training on the iPad (Hall, 2013) were asked to review their current caseloads to identify potential candidates who met set inclusion and exclusion criteria (See Appendix A for recruitment flyer). Students were considered eligible to participate in the current study based on the presence of the following criteria: (1) enrolled in an elementary school in the seacoast region of New Hampshire, (2) between the ages of 5-9 years of age, (3) had a documented diagnosis of developmental disability/delay, (4) presented with CCNs defined as the inability to meet daily communication needs using his or her voice, (5) received speech and language therapy from a school-based SLP, and (6) perceived (by the SLP's clinical judgment) to potentially benefit from

implementation of speech-generating technology. Students were excluded from participation if he/she (1) had been exposed to the speech generating app selected for use in the study (as described below) prior to participation in this study, (2) was over the age of 10, (3) could communicate effectively using natural speech defined as using his/her voice to make requests, refusals, or carry-on social interactions with communication partners, and/or (4) was not currently on the caseload of a participating SLP. Each SLP identified only one potential student on their current caseloads who met set criteria. The SLPs contacted the parents of potential student candidates who met criteria to provide information about the study, present informed consent forms (See Appendix B), and obtain verbal consent for the researcher to contact them with further information and to answer questions. If parents expressed interest in their child's participation, the researcher scheduled an informational meeting. During the informational meeting, the researcher reviewed informed consent documents and answered any questions (see Appendix C for informational meeting script). As there are special considerations to take into account when using children as research participants, in addition to obtaining informed consent from each student's parents, the SLPs were responsible for obtaining child assent at the beginning of each speech and language therapy session in which data were collected for this study (see Appendix D for assent communication board and assent protocol). The recruitment process for student participants was considered completed once parents returned informed consent forms to either SLPs or directly to the researcher.

Incentive. Upon fulfilling his or her commitment to the study, each student received a $50 VISA gift card as appreciation for his or her time.

Settings

This study took place in three different elementary schools housing grades ranging from preschool to 5th Grade. Refer to Table 2 for setting demographics.

Table 2

Educational Settings' Characteristics

Setting Characteristics	Setting 1	Setting 2	Setting 3
Grades	K - 5	1 - 4	Pre-K - 5
Average # of Students School-wide	350	430	600
Average Classroom Size	22	22	20
Average Teacher/Student Ratio	1:7	1:20	1:12

Materials

The following materials were used throughout the duration of the study.

iPad 2. A white, 16 GB Apple, Inc. iPad 2 was provided to each of the SLPs. A black iPad OtterBox case with screen protector was provided with each iPad to serve as protective covering.

Speak for Yourself! (*SFY*). The *SFY* app, released in January 2012 (LoStracco & Collender, 2012), was selected for use on the iPad2 for this study. *SFY* uses speech-generating technology and is available to purchase for either Android or iPad devices. *SFY* presents with a similar representation of pre-existing systems using Unity Language software (Prentke Romich Company, 2012) used on SGDs such as the Eco and Vantage.

SFY was selected for this pilot study since it was the first iPad app of its

kind that mirrored pre-existing SGD technology. The organization of *SFY* is consistent with motor learning principles. This approach is referred to as *Language Acquisition through Motor Planning* (LAMP) and is promoted by the Prentke Romich Company and The Center for AAC & Autism (http://www.aacandautism.com/). The primary principle of the motor planning approach is the assumption that language acquisition for those using SGDs is more automatic if symbols are kept in the same locations. Therefore, motor movements for selection of the symbols to produce specific vocabulary remain the same, supporting the development of "motor memory." This process is comparable to the development of consistent motor patterns associated with speech. With repeated use of the SGD, language output becomes more automatic as if the user were using the SGD like a person who uses natural speech uses his articulators (The Center for AAC & Autism, 2009).

SFY uses a word-based vocabulary of the most frequently used words in communication and contains features important to developing automaticity and language. *SFY* has the capability to begin use with minimal vocabulary and continue to expand as the user acquires more language. *SFY* contains almost 11,000 Smarty Symbols® and allows the user to access over 13,000 words with no more than two touches to say a word. This app can be programmed and customized according to the language needs of a particular individual. Features of this app that support learning to use the system and customization include: *Open and Close, Babble, Lock Edit, Edit and Add Words, and No Duplication.* Table 3 provides descriptions regarding the functions of *SFY* features.

Table 3

Functions of the Speak For Yourself! App Features

SFY Features	Function
Open and Close	Allows users to begin with only one word and add new vocabulary at their own pace.
Babble	Allows users to explore vocabulary by opening every word in the app, while preserving previous programming.
Lock Edit	Inhibits the user from making accidental changes to the programming. Selecting the "lock" button disables the editing functions of the app.
Edit and Add Words	Allows users to edit existing vocabulary and add customized vocabulary.
No Duplication	Prevents a vocabulary word from being added to multiple locations within the app. This feature also provides a "find a word" function that shows the person programming the motor sequence to find the desired vocabulary.

SLP training on use of *SFY*. Each student's SLP participated in specific training regarding the use of the *SFY* app on the iPad (Hall, 2013). Prior to implementing use of SFY with the student, each SLP completed three training modules, each approximately ten minutes in length, regarding the programming and implementation of *SFY*. SLPs were trained in order be able to implement the use of the speech-generating app on the iPad adequately. The three topics covered in these modules were titled: (1) The Research Base for AAC, (2) Introduction to *SFY,* and (3*) SFY* Features. Short videos were embedded into each module to demonstrate specific features of the iPad 2 and *SFY*. The videos embedded within these modules were recorded using a 16 GB Apple iPad 2 with

the preloaded recording software provided in the "camera" app. Each video provided a close-up of the *SFY* screen on an iPad 2 with real time instruction on how to utilize each feature of the app. Videos were edited using iMovie, a program preloaded on most Mac computers. Talking points for each video were provided on a corresponding set of PowerPoint slides. The SLPs could access the training modules in two ways: either view on Google Docs via secure login to Gmail created for this research or via CD-R provided by the researcher. SLPs had access to the training modules to refer to as needed throughout the course of the study.

Data collection sheet. Using Microsoft Word, the researcher developed a data collection sheet for each SLP to track student performance on three variables of interest (communication goals) as defined in the Measures section. Data were collected at three points during the study (baseline, mid-intervention, and post-intervention as described in the Research Design). See Appendix E for a copy of the data collection sheet.

Weekly monitoring sheet. Using Microsoft Word, the researcher developed a weekly monitoring sheet to ensure implementation of intervention. This sheet provided places for the SLP to handwrite the session's objectives related to each variable of interest, an informal rating scale (to provide information regarding the level of the student's performance for that particular session), and a place for narrative notes pertinent to the outcome of the session. The weekly monitoring sheet was used exclusively as a mode to monitor fidelity

of intervention; not for data collection purposes. See Appendix F for a copy of the weekly monitoring sheet.

Measures

The following steps in this research study were aimed to measure the progress of each student towards achieving three individually selected communication goals (variables of interest) using the iPad 2 with the *SFY* app as a SGD.

Determination of variables of interest. After obtaining parental consent for the student to take part in the study, the researcher and the student's SLP conducted a file review specific to each student participant (i.e., therapy progress reports, IEP goals, diagnostic reports, etc.) to determine three unique variables of interest (i.e. communication goals to be addressed using the iPad 2 and *SFY*). Variables of interest for each participant differed because each participant's level of communicative skill was different.

The level of skill related to each variable of interest was operationally defined using Goal Attainment Scaling (GAS) (Cardillo & Choate,1994) prior to the initiation of baseline data collection. GAS has been shown to be an effective data measurement tool that can reliably track meaningful progress over time (Mailloux et al., 2007; National Professional Development Center on ASD, 2009). This methodology is useful for measuring progress on meaningful individualized intervention goals with a diverse population such as those with DD. GAS scores are qualitative judgments ranked in numerical form using a 5-point scale (-2 to +2) to rate progress related to specific goals. Zero (the midpoint of the scale) is

used to indicate the predicted level of performance (Cardillo & Choate,1994). Progress that is somewhat less than expected or somewhat more than expected would receive a rating of -1 and +1, respectively. Progress that is much less than expected or much more than expected would receive a rating of -2 and +2, respectively. Each SLP, with assistance from the researcher, developed a rubric that defined each of the five points on the scale for each variable of interest prior to the implementation of the intervention (see Appendix G) for an example of GAS). The variables of interest and rubrics based on the GAS for each student participant are presented in the Results section.

Data Collection

Data collection points. The SLPs were responsible for data collection at three different points during the study (baseline, mid-intervention, post-intervention). Each SLP completed a data collection sheet for each of the three variables of interest defined during the GAS process for the student. Each data collection sheet provided spaces to add a definition for each of the five points on the GAS. Circling the point on the GAS marked the SLP's judgment regarding the student's performance levels at that time. Each SLP was provided with the set of required data collection sheets at the start of the study.

Collection of the data sheets. At the end of the twelve-week study, all of the data and weekly monitoring sheets were collected from each SLP. The data and weekly monitoring sheets were then scanned and saved onto a secure, password protected, encrypted server.

Research Design

This research was a series of three case studies (Yin, 2009) in which each student had three variables of interest that were aligned with three communication therapy goals and were operationally defined using GAS. Data were collected at three points to assess each student's progress on the variables of interest over time.

Baseline data. Baseline data collection was completed during the first 2 weeks of regularly scheduled speech and language therapy sessions prior to the implementation of *SFY* on the iPad 2. SLPs used clinical judgment to rate the student's level of skill for each variable of interest (communication goal) measured using the GAS rating scale on the data collection sheet.

Mid-intervention data. At the midpoint of the intervention period (week 6), the SLPs completed the same data collection sheet used during baseline. Using clinical judgment, the SLPs determined the GAS rating that corresponded to the student's performance on each variable of interest (communication goal) at that time.

Post-intervention data. At the end of the 12-week intervention period, the SLPs were asked to record the GAS ratings for each variable of interest for the student on the data collection sheet.

Intervention

Once the intervention phase of the study began, SLPs were required to implement *SFY* on the iPad 2 in regularly scheduled speech and language therapy at least once per week with the student for a total of 12 weeks. SLPs

were expected to continue with their usual therapy, with the addition of *SFY* on the iPad 2.

SLPs were expected to participate in weekly monitoring via note-taking procedures. After each weekly session, SLPs made notes regarding the types of activities planned for that session, the students' performance, and notable student behaviors. This protocol provided a mode of documentation of implementation of intervention (refer to Appendix F). Therapy sessions were not monitored separately by the researcher to ensure as natural experience for the students as possible.

Prior to introducing the iPad during each session, the SLP was required to obtain assent from the student participant (refer to Appendix D).

Results

Each of the three students remained active in participation for the duration of the study. Data collection began Monday, October 29th 2012 and concluded on Friday, February 2nd 2013 totaling 12 weeks of intervention during which an iPad 2 with the *SFY* app was implemented in regularly scheduled speech-language therapy sessions at least once weekly. Changes in the students' level of skill in regards to three specific communication goals (variables of interest) based on GAS procedures were reported based on completion of data collection sheets by each student's school SLP at three specific points over the course of the study (at baseline, following six weeks of intervention, and at the end of the study).

Data Analysis

Data gathered from this series of three case studies were analyzed using the method of visual graphing and analysis (Yin, 2009). Descriptions of the three variables of interest for each student are presented. Changes in each student's levels of skill over time and descriptive summaries of each student's skills at each data collection point are described below.

Michael.

Variables of interest. The definitions for the three variables of interest (communication goals) and the corresponding rubric for each based on GAS for Michael are presented in Tables 4 and 5.

Table 4

Variables of Interest for Michael

Variables of Interest		
1	2	3
Within a carrier phrase (I/he/she _____) Michael will use *SFY* to label 5 verbs with pronouns 4/5 opportunities, with no more than 1 prompt for each phrase.	Michael will use *SFY* to label 5 presented objects with name and an adjective in 4/5 opportunities with no more than 1 prompt for each item.	Michael will continue to expand his use of functional words using his *SFY* to indicate choice/ preference, negation, or to indicate wanting more in 4/5 opportunities with no more than 1 prompt.

Table 5

Operational Definitions of the Variables of Interest for Michael

Goal Attainment Scale	Variables of Interest		
	1	2	3
2 Much more than expected	Michael will use *SFY* to label 8 verbs with pronouns in 4/5 opportunities, independently.	Michael will use *SFY* to label 8 presented objects with name and adjective in 4/5 opportunities independently.	Michael will continue to expand his use of functional words using *SFY* to indicate choice/preference, negation, or to indicate wanting more in 5/5 opportunities independently.
1 Somewhat more than expected	Michael will use *SFY* to label 5 verbs with pronouns in 4/5 opportunities, independently.	Michael will use *SFY* to label 5 presented objects with name and adjective in 4/5 opportunities independently.	Michael will continue to expand his use of functional words using *SFY* to indicate choice/ preference, negation, or to indicate wanting more in 4/5 opportunities independently.
0 Expected Level of Outcome	Goal Attained	Goal Attained	Goal Attained
-1 Someone less than expected	Michael will use *SFY* to label 5 verbs with pronouns in 4/5 opportunities, with no more than 2 prompts for each phrase.	Michael will use *SFY* to label 5 presented objects with name and an adjective in 4/5 opportunities with no more than 2 prompts for each item.	Michael will continue to expand his use of functional words using *SFY* to indicate choice/ preference, negation, or to indicate wanting more in 4/5 opportunities with no more than 2 prompts.
-2 Much Less than expected	Michael will use *SFY* to label 5 verbs with pronouns in 4/5 opportunities, with maximum assistance.	Michael will use *SFY* to label 5 presented objects with name and an adjective in 4/5 opportunities with maximum assistance.	Michael will continue to expand his use of functional words using *SFY* to indicate choice/ preference, negation, or to indicate wanting more in 4/5 opportunities with maximum assistance

Progress over three data collection points. Figure 1 presents the SLP's ratings of Michael's performance for each variable of interest at baseline, at six weeks of intervention, and at the end of the study.

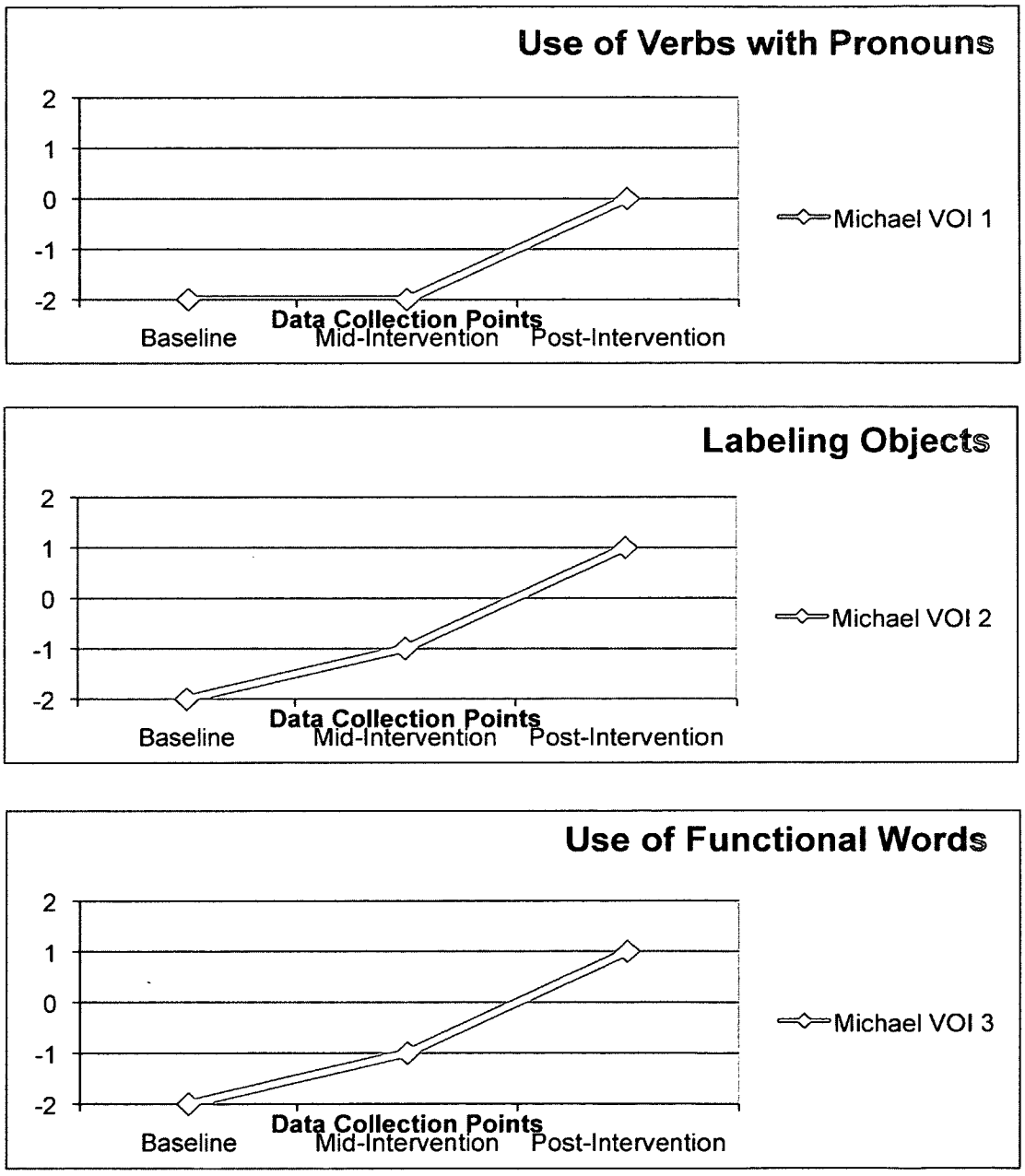

Figure 1. Michael's performance over time in regards to three variables of interest as measured by Goal Attainment Scaling.

Baseline. When initially exposed to the *SFY* app at baseline, Michael's SLP reported that maximal assistance was needed, including direct instruction and repeated direct models, for him to be successful using *SFY* for each of the targeted communication goals. For each of the variables of interest (labeling verbs with pronouns, labeling objects and a related adjective, and use of function words to indicate choice/preference, negative, or wanting more), the GAS rating was -2 (see Figure 1).

Mid-intervention. As shown in Figure 1, Michael's performance remained at a rating of -2 on the GAS scale for variable of interest 1,with maximum support for success using *SFY* to label five verbs with pronouns in 4/5 opportunities. For variable of interest 2, Michael's performance increased to a rating of -1 on the GAS rating scale. He was able to use *SFY* to label five presented objects with name and an adjective in 4/5 opportunities with no more than two prompts for each item. For variable of interest 3, Michael's performance increased from baseline to a rating of -1 on the GAS scale. He was able to use functional words using *SFY* to indicate choice/preference, negation, or to indicate wanting more in 4/5 opportunities with no more than two prompts.

Post-intervention. For variable of interest 1, Michael's performance reached the expected level of outcome with a rating of 0 on the GAS rating scale by week 12 of intervention. Michael used *SFY* to label five verbs with pronouns 4/5 opportunities within a carrier phrase (e.g., "I/he/she _____"), with no more than one prompt for each phrase. Michael's performance exceeded the expected levels of outcome for variables of interest 2 and 3. Each was rated at 1 on the

GAS scale. For variable of interest 2, Michael was able to use *SFY* to label five presented objects with name and adjective in 4/5 opportunities independently. For variable of interest 3, Michael was able to independently produce functional words using *SFY* to indicate choice/preference, negation, or to indicate wanting more in 4/5 opportunities.

Elsa.

Variables of interest. The definitions for the three variables of interest (communication goals) and the corresponding rubric for each based on GAS for Elsa are presented in Tables 6 and 7.

Table 6

Variables of Interest for Elsa

Variables of Interest		
1	**2**	**3**
Elsa will use 4-6 targeted verbs (eat, drink, want, play, see, wear, and ride) in phrases in 4/5 opportunities in response to a prompt across settings.	Elsa will use yes/no to respond to basic questions (about family photos, activities, and self/family) in response to a prompt in 4/5 opportunities	Elsa will use *SFY* to respond to 4 questions related to self-care (clothing, personal care) with 80% accuracy.

Table 7

Operational Definitions of the Variables of Interest for Elsa

Goal Attainment Scale	Variables of Interest		
	1	2	3
2 Much more than expected	Elsa will use 6 or more targeted verbs (eat, drink, want, play, see, wear, and ride) independently in response to questions.	Elsa will use yes/no to respond to questions during varied activities throughout the day with 80% accuracy	Elsa will use *SFY* to respond 8 questions related to self-care (clothing, personal care) with 80% accuracy.
1 Somewhat more than expected	Elsa will use 4-6 targeted verbs (eat, drink, want, play, see, wear, and ride) independently in response to questions in 4/5 opportunities.	Elsa will use yes/no to respond to all listed activities with 80% accuracy.	Elsa will use *SFY* to respond 6 questions related to self-care (clothing, personal care) with 80% accuracy.
0 Expected Level of Outcome	Goal Attained	Goal Attained	Goal Attained
-1 Someone less than expected	Elsa will use 3-4 targeted verbs (eat, drink, want, play, see, wear, and ride) in phrases in 4/5 opportunities given a model and prompt.	Elsa will use yes/no to respond to basic questions (about family photos, activities, and self/family) with 60% accuracy following a prompt.	Elsa will use *SFY* to respond to 4 questions related to self-care (clothing, personal care) independently with 60% accuracy.
-2 Much Less than expected	Elsa will use one targeted verb (eat, drink, want, play, see, wear, and ride) in phrases in 4/5 opportunities given a model and prompt.	Elsa will use yes/no to respond to basic questions (about family photos, activities, and self/family) with 40% accuracy given a model.	Elsa will use *SFY* to respond to 4 questions related to self-care (clothing, personal care) given a direct model with 60% accuracy.

Progress over three data collection points. Figure 2 presents the SLP's ratings of Elsa's performance for each variable at baseline, following six weeks of intervention, and at the end of the study.

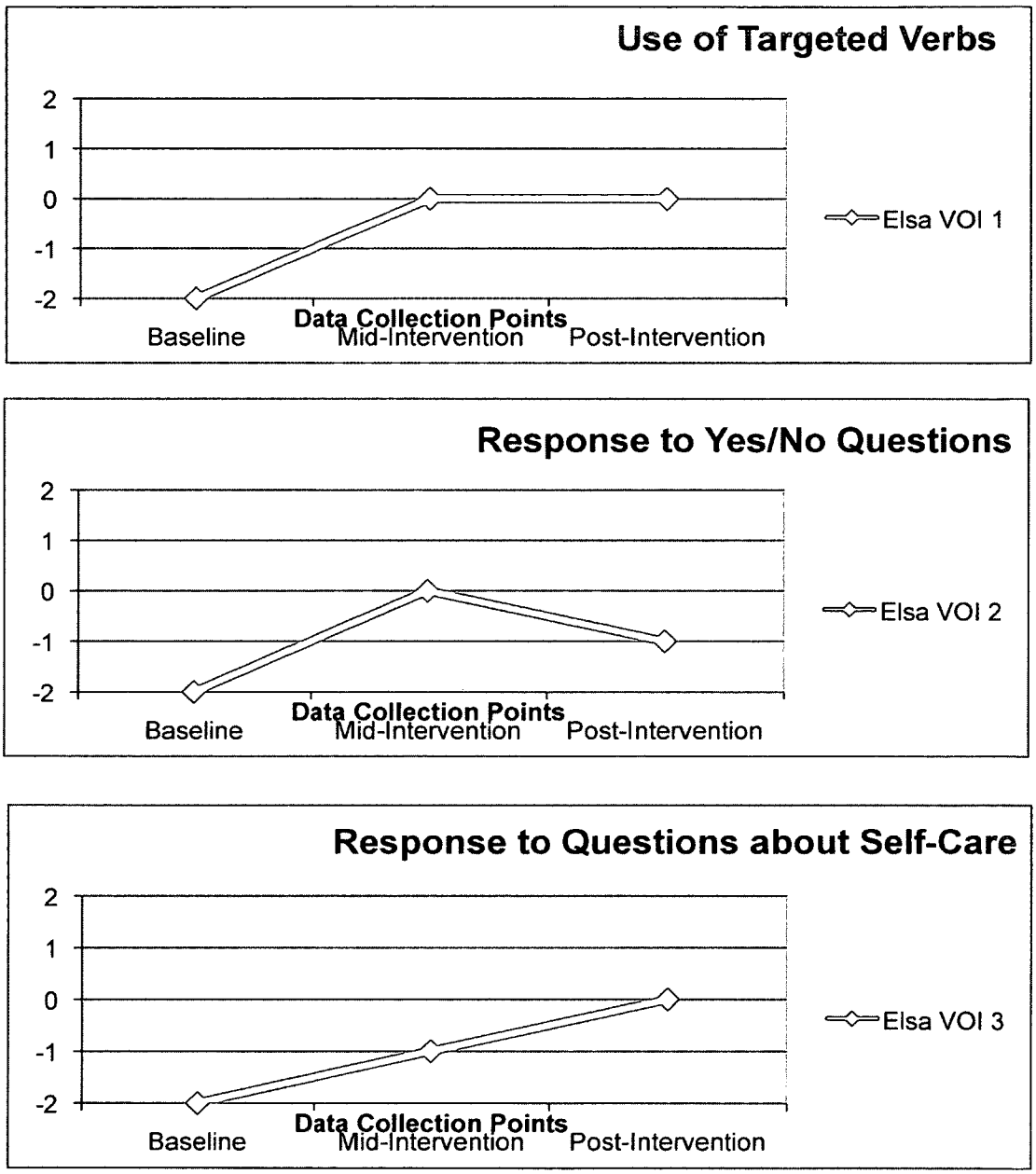

Figure 2. Elsa's progress over time in regards to three variable of interest as measured by Goal Attainment Scaling.

Baseline. When initially exposed to the SFY app at baseline, Elsa's SLP reported that most of the baseline session was spent introducing and modeling vocabulary using SFY for each of the targeted communication goals (using verbs, responding to yes/no questions, and responding to questions related to self-care). The SLP reported that although Elsa needed models and prompts for success, she appeared to pick up on the format quickly to use verbs when first exposed to the app. Elsa required visual prompts (shaking of head) and models to differentiate between "yes" and "no." For each of the variables of interest, the GAS rating was -2 (see Figure 2).

Mid-intervention. As shown in Figure 2, Elsa met the expected level of outcome for variable of interest 1 by demonstrating use of 4-6 targeted verbs in phrases in 80% of opportunities in response to a prompt by week 6 of the intervention period. Elsa's performance also increased to the expected level of outcome for variable of interest 2. She demonstrated the use of yes/no in response to basic questions (about family photos, activities, and self/family) in response to a prompt with 80% accuracy. For variables of interest 1 and 2, the GAS ratings were 0. Progress was also documented for variable of interest 3. Elsa demonstrated the use of *SFY* to respond to four questions related to self-care (clothing, personal care) independently with 60% accuracy. Elsa's SLP noted increased familiarity with presented vocabulary for clothing and toiletry items for baby doll play the emergence of spontaneously requests for these items using *SFY* during play. For variable of interest 3, the GAS rating was -1 (see Figure 2).

Post-intervention. As shown in Figure 2, Elsa's performance at week 12 remained unchanged from the mid-intervention data collection period for variable of interest 1. Her performance remained at the expected level of outcome, as she continued to be able to use targeted verbs in response to a prompt with 80% accuracy. For variable of interest 1, the GAS rating was 0. Elsa's performance for variable of interest 2 showed regression in skill between the mid- and post-intervention periods. The SLP reported that at the time of the week 12 data collection Elsa could successfully answer questions requiring the use of "yes," but became frustrated when prompted to answer with "no". For variable of interest 2, the GAS rating was -1. For variable of interest 3, Elsa's level of performance increased to the expected level of outcome, as she was able to use *SFY* to respond to four questions related to self-care (clothing, personal care) with 80% accuracy. For variable of interest 3, the GAS rating was 0. During the post-intervention period, Elsa's SLP commented that Elsa's performance with *SFY* varied from session to session, often depending on how much time there was between sessions, review of the vocabulary, and type of activities.

David.

Variables of interest. The definitions for the three variables of interest (communication goals) and the corresponding rubric for each based on GAS for David are presented in Tables 8 and 9.

Table 8

Variables of Interest for David

Variables of Interest		
1	**2**	**3**
David will independently select the correct pronoun given a picture stimulus and verbal query for all types presented (subjective, objective, and possessive) with 40% accuracy.	David will independently select the correct verb tense when given a picture stimulus and verbal description/ query for all types presented (present progressive, regular past, & future) with accuracy of 40%	David will independently select the correct preposition when given a picture stimulus and verbal query for all types presented (in, on, under, in back next to/beside, between, top, bottom) with accuracy of 40% or greater.

Table 9

Operational Definitions of the Variables of Interest for David

Goal Attainment Scale	Variables of Interest		
	1	2	3
2 Much more than expected	Independently selects the correct pronoun when given a picture stimulus and verbal query for all types presented with accuracy of 80% or greater.	Independently selects the correct verb tense when given a picture stimulus and verbal description/ query for all types presented with accuracy of 80% or greater.	Independently selects correct preposition when given a picture stimulus and verbal query for all types presented with accuracy of 80% or greater.
1 Somewhat more than expected	Independently selects the correct pronoun when given a picture stimulus and verbal query for all types presented with 60% accuracy.	Independently selects the correct verb tense when given a picture stimulus and verbal description/ query for all types presented with accuracy of 60%.	Independently selects correct preposition when given a picture stimulus and verbal query for all types presented with accuracy of 60% or greater.
0 Expected Level of Outcome	Goal Attained	Goal Attained	Goal Attained
-1 Someone less than expected	Partial physical prompting to select the correct pronoun when given a picture stimulus and verbal query for all types presented with 100% accuracy.	Partial physical prompting to select the correct verb tense when given a picture stimulus and verbal description/ query for all types presented with 100% accuracy.	Partial physical prompting to select correct preposition when given a picture stimulus and verbal query for all types presented with 100% accuracy.
-2 Much Less than expected	Full hand-under-hand prompting to select the correct pronoun when given a picture stimulus and verbal query for all types presented with 100% accuracy.	Full hand-under hand prompting to select the correct verb tense when given a picture stimulus and verbal description/ query for all types presented with 100% accuracy.	Full hand-under hand prompting to select correct preposition when given a picture stimulus for all types presented with 100% accuracy.

Progress over three data collection points. Figure 3 presents the SLP's ratings of David's performance for each variable at baseline, six weeks of intervention, and at the end of the study.

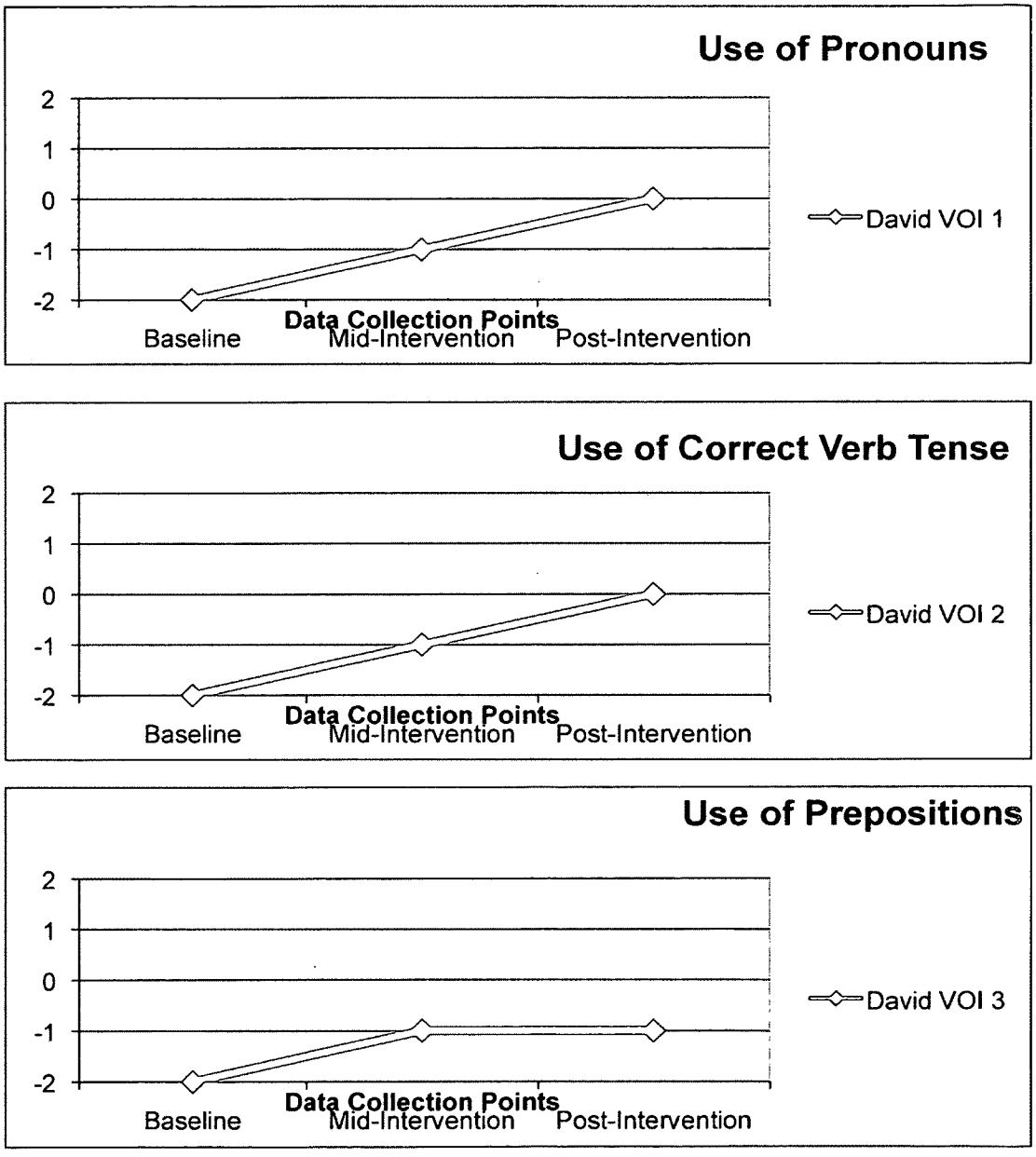

Figure 3. David's performance over time regarding three variables of interest as measured by Goal Attainment Scaling.

Baseline. When initially exposed to the app, David's SLP reported that maximum support was needed, including full hand-under-hand prompting for David to be successful using *SFY* for each of the targeted communication goals. For each of the variables of interest (using pronouns, using correct verb tense, and using prepositions) the GAS ratings were -2.

Mid-intervention. As shown in Figure 3, an increase in performance was reported for all variables of interest at week 6. David's SLP reported the need for partial physical prompting for successful use of *SFY* for all three communication goals (using pronouns, using correct verb tense, and using prepositions). For variables of interest 1, 2, and 3 the GAS ratings were -1.

Post-intervention. For variable of interest 1, David's performance increased to the expected level of outcome as he demonstrated the ability to independently use targeted pronouns in response to a picture stimulus and verbal query for all types presented (subjective, objective, and possessive) with 40% accuracy. David's performance also increased to the expected level of outcome for variable of interest 2. David demonstrated the ability to independently select correct verb tense in response to a picture stimulus and verbal description/ query for all types presented with 40% accuracy. The GAS ratings were 0 for variables of interest 1 and 2. Performance for variable of interest 3 remained the same as during the intervention period with a GAS rating of -1.

Discussion

The purpose of this pilot study was to investigate the efficacy of the use of the Apple iPad as a SGD using the *Speak for Yourself! (SFY)* speech-generating app by measuring three students' progress towards individual communication goals. Overall, the results were positive. According to their school-based SLPs, all three students with CCNs made progress towards, reached, or exceeded expectations on three communication goals over a period of 12 weeks when using iPad with *SFY* in regularly scheduled speech-language therapy. At baseline, all three participants were rated -2 on the GAS for performance on all communication goals. By post-intervention, two of the three student participants (David and Elsa) reached the expected level of outcome for 2 out of 3 selected communication goals. The third participant (Michael) achieved the expected level of outcome for 1 communication goal while exceeding the expected level of outcome for the remaining 2 goals. Only one student (Elsa) showed mild regression for one variable of interest (answering yes/no questions). Elsa's SLP attributed the regression from 0 to -1 to an aversion to using "no" as an answer to questions rather than lack of skill navigating *SFY.*

The findings from this study provide preliminary support for the hypothesis that students with CCNs can make progress toward individual communication goals when using a speech-generating app on the iPad. These findings also contribute to the emerging evidence for the iPad's use as a viable SGD with students who have DDs and CCNs (Kagohara et al., 2010; van der Meer et al.,

2011; van der Meer, Didden, et al., 2012; van der Meer, Kagohara, et al., 2012; van der Meer).

This pilot study is unique in terms of measuring each participant's progress toward his or her *individual* communication goals in contrast to other preliminary studies that measured progress in regards to one *pre-determined* communicative function (e.g., requesting) using speech generating apps (Achmadi et al., 2012; Flores et al., 2012; Kagohara et al., 2010; van der Meer et al., 2011; van der Meer, Didden, et al., 2012; van der Meer, Kagohara, et al., 2012; van der Meer, Sutherland et al., 2012). This research focused on three school-aged students age 5-9 with DDs and CCNs using the iPad in an *educational* setting, while the aforementioned studies had a combined range of 1-5 participants from 4-23 years of age, who have DDs and present with CCNs who used the iPad in a *research* setting. Additionally, the implementation of the use of the iPad with the *SFY* app in this study was performed by each student's *school-based SLP* rather than a *researcher*. This supported a more natural measurement of the implementation of the iPad as part of a student's AAC system in a typical setting.

Furthermore, this research is unique as it employed a speech-generating app that has not been the focus of investigation to date, yet mirrors pre-existing, dedicated speech-generating technology. This factor is imperative as the ability to apply what is known about motor-planning with dedicated communication devices to iPad technology provides a manner in which to bridge this emerging technology with pre-existing technology that is currently supported by research.

Intervention

Based on the positive findings, the intervention procedure used in this pilot study was considered to be successful within the confines of participation guidelines. Students with CCNs responded positively to the implementation of the iPad with SFY by their school-based SLP in only one weekly structured speech-language therapy session. This would be considered a modest level of intervention, as most students with CCNs receive speech and language therapy several times per week. If intervention were more intensive such as implementation within therapy and across the school day, one would expect to see use of the device in a more functional, naturalistic, and/or conversational manner.

The use of GAS ratings by the students' SLP was found to be a useful measure of progress towards individual communication goals. This rating scale provided an individualized, yet streamlined mode of measuring progress and defining how specific levels of progress would be exhibited for each student.

Barriers to implementation. The greatest barrier to implementation of the speech-generating app on the iPad into regularly scheduled speech-language therapy was SLPs' level of experience with implementing AAC in general. Two out of the three SLPs had minimal experience working with AAC systems prior to the launch of the study. Though each SLP completed a training protocol for the programming and use of *SFY* on the iPad, the training did not include specific information regarding the broader field of AAC or best practices for the successful implementation of an AAC system within an educational

setting. For example, the training protocol could have included strategies for supporting acceptance and use of AAC by other professionals within their educational settings. This type of barrier often prevents the generalized use of AAC outside of one-on-one speech-language therapy.

Fidelity. The fidelity with which the iPad with *SFY* was implemented in the pilot study was measured indirectly by the SLPs' completion of the data collection and weekly monitoring sheets. Periodic observations of the SLPs, weekly collection of monitoring sheets, and use of a fidelity checklist by someone other than the researcher would have strengthened this measurement.

Limitations

The following have been acknowledged as limitations to the present pilot study.

Time and resources. As this research was executed as part of a Master's Thesis project, allotment of time and level of resources serve as limitations. First, the data collection period was limited to 12 weeks. Typically, IEP goals are measured over the course of the school year (9 months). Additionally, financial limitations created a cap of three iPads available for use by the SLPs. Each SLP only had one student on their caseload who met the inclusion / exclusion criteria, limiting the total number of participants to 3 students.

Research design. This research would have been stronger in nature had it followed a single case research, ABA design with repeated measures. Data collection only occurred at three different points during the study with the last data point occurring at the end of the last week of intervention. Multiple data

collection points during the baseline, intervention, and post-intervention periods would strengthen the interpretation of progress. Additionally, data taken a period of time after the pilot study concluded to see if gains were maintained would strengthen the efficacy of results.

Functional communication skills. Although results of the study were positive, successful use of an AAC system in structured activities during one on one service delivery does not adequately illustrate an individual's increase in functional communication skills in daily activities. Measurement of the students' use in activities in the classroom would have contributed to understanding the generalization and use of the iPad with *SFY* for functional communication skills outside the therapy setting.

Bias. All of the participants in this research, including the SLPs and the researchers, were aware of the purpose of the study and expected outcomes. Such knowledge could have created bias in the data collection and the interpretation of the results, and as such, is a limitation of this study.

Validity.

Internal Validity. Due to the lack of adequate fidelity measures to ensure the SLPs were implementing the iPad with *SFY* as intended and an intervention protocol that required implementation only once per week, it is not possible to determine if gains towards goals could be fully attributed to the intervention. Students' continued to receive typical speech-language therapy throughout the study. Although this serves as a limitation, ethically, the researcher could not require other intervention to cease once the study began.

External Validity. Students were chosen to participate in this study based on the presence of CCNs, not the presence of a specific diagnosis. This serves as both a limitation and strength. It cannot be said each participant was truly representative of a certain population, which is a limitation. However, all students made progress towards individual communication goals, which serves as a relative strength of this study. As such, the intervention protocol could be replicated and implemented by other professionals with students with CCNs resulting from other communication disorders and/or disabilities.

Data collection. This pilot study required three different SLPs to collect data for three different participants—none of whom were the researcher. Concerns regarding internal validity and bias could arise; SLPs always want to see their students perform well and make progress towards their communication goals. Additionally, the GAS procedures were under the interpretation of three different forms of clinical judgment. Standardized training regarding data collection and use of the GAS procedures across SLP participants could have lessened the potential effect on internal validity.

Clinical Implications and Future Research

The use of iPad technology for AAC continues to grow in popularity. Use of the iPad as a SGD may seem more advantageous to users than more traditional dedicated SGDs. The iPad with speech generating apps are relatively inexpensive (Sutherland et al., 2010), relatively more portable, and less stigmatizing than other more traditional dedicated SGDs (Mirenda, 2009). Considering guidelines for implementing EBPs outlined by Schlosser and

colleagues (2004), despite the initial appeal of using the iPad as a SGD, this relatively new practice will not be considered evidence-based until it has been implemented and evaluated by many who then disseminate the results for review by researchers, clinicians, and potential users. As positive evidence is accumulated, the iPad and other tablet technologies may then be more widely recommended as part of an AAC system for individuals with DDs based on empirical evidence supporting its use. Additionally, if this technology becomes more widely used, there will be a greater need for programming and operation competency for SLPs, rehabilitation assistants, classroom teachers, and parents to support successful implementation of the iPad as a SGD. Research will need to address the design and evaluation of effective training techniques and technical assistance for the various apps available.

While current comparison studies have evaluated the use of iPod/iPad-based SGDs in comparison with manual signs and/or picture-based systems, future research should compare the use of an iPad with pre-existing dedicated SGDs as well as comparison of the outcomes using different speech generating apps. Research should be performed to compare the communication options in multiple areas including user preference, usability, ease of implementation, measure of user outcomes, and cost.

Future research investigating iPads as SGDs should include the integration of the iPad as the SGD as part of an individual's AAC system in daily activities. Its use should be measured over a considerable period of time and implementation should be across all settings and contexts of the user's life. The

field of AAC is in need of positive illustrations of what the presence and carry-through of AAC should look like in terms of inclusion and participation of the user in educational as well as community settings.

While the results of this pilot study are promising, they should be considered preliminary given the small number of participants and limitations in terms of service-delivery. Michael, Elsa, and David made progress towards specific communication goals during individual speech-language therapy sessions. Ideally, implementation of AAC should be across settings, contexts, and communication partners.

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Appendix A

Recruitment Flyer

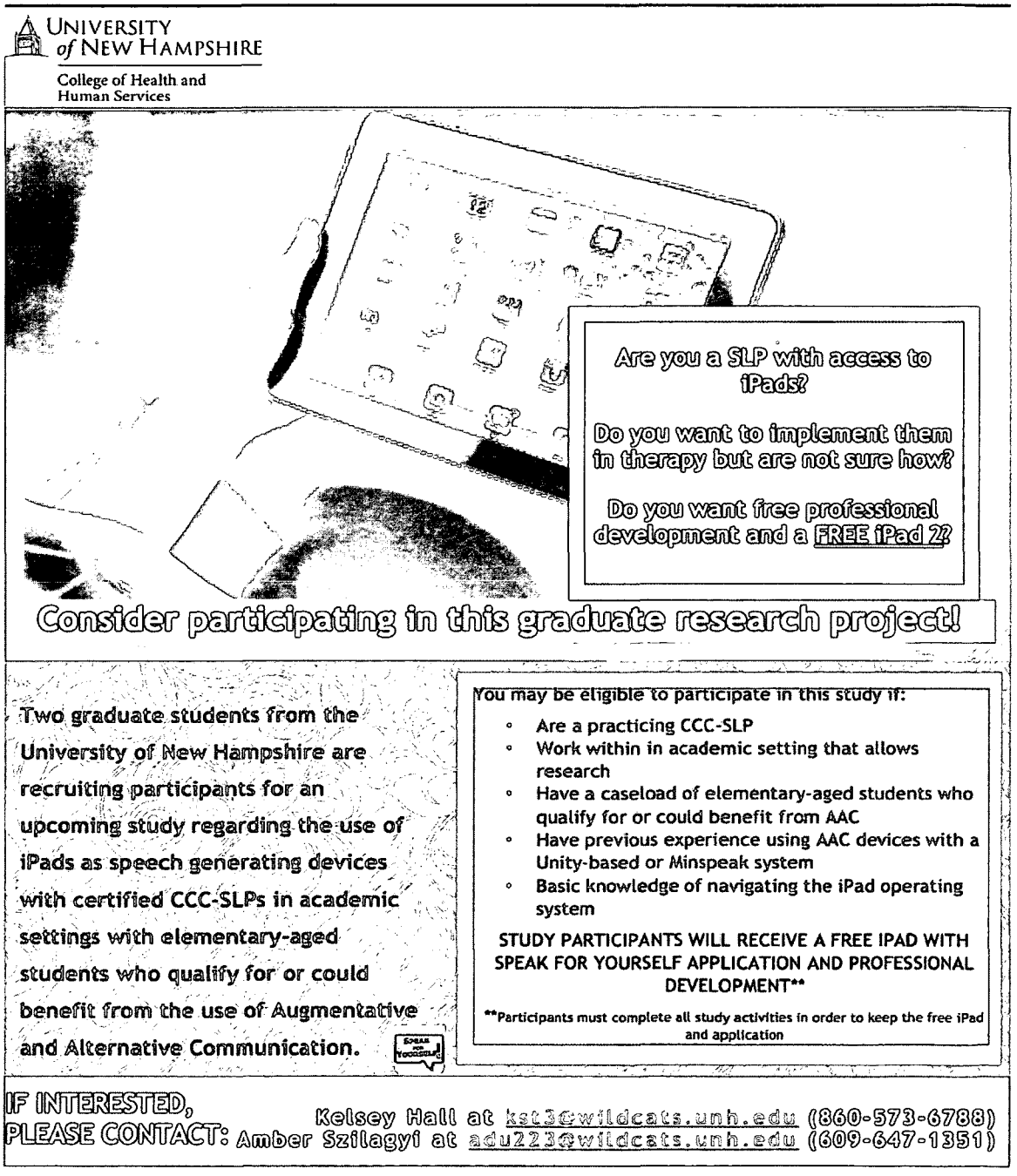

Figure D1. This flyer was developed to disseminate to known contacts.

Appendix B

Parent Informed Consent

Title of Research Study
The title of this study is "Emerging Technology: Efficacy of Using iPads as Speech-Generating Devices with Students Who Have Complex Communication Needs in Academic Settings". We are two speech-language pathology graduate students at the University of New Hampshire.

What is the purpose of this study?
The purpose behind this research study is to compare functional communicative skills of students with complex communication needs pre-, mid-, and post-intervention (the implementation of the iPad and *Speak for Yourself!* application) to determine if this specific intervention led to an increase in the areas of communication being measured for each student—therefore supporting the efficacy of this intervention with this population.

There will be approximately 3 school-aged participants who will be involved in the study. Each student will be working their his or her school SLP.

What does your child's participation in this study involve?
Your child will be asked to:

- Engage use of the iPad with *Speaking for Yourself!* Application during regularly scheduled speech and language therapy sessions at school with the child's speech language pathologist.
- Use of the iPad with *Speaking for Yourself!* Application will be focused on communication goals defined in the child's IEP.
- Nothing beyond time spent in weekly scheduled speech and language therapy.

Your child will be asked at the beginning of each session if he or she would like to join the SLP to play a game on the iPad. The SLP will use a choice board as a visual support. Your child will then be given time to respond to the best of his or her ability (circle, x-out, etc.) whether he or she would like to participate. If your child indicates that he/she does not want to use the iPad during a given session, the use of the iPad will discontinue at that time. The SLP will reintroduce the iPad if your child appears interested in re-engaging.

Your child is not required to commit any more time to this study than the time during regularly scheduled therapy sessions with his or her current school SLP when the SLP is using the iPad.

The timeline for the study is projected to be from mid-September 2012 to the end of January 2013.

Early September	Mid September – Mid-October	Mid-October – Mid-January	End of January
Determination of dependent variables for each student participant.	Collection of Baseline Data	Implementation of *Speak For Yourself!* in regularly scheduled weekly therapy sessions	Final Data Collection and analysis

Your child's speech language pathologist will perform the following tasks for this study:

1. *Student Recruitment:* SLPs will be asked to identify student(s) who meet the inclusion/exclusion criteria for possible participation this study. To maintain confidentiality, you will asked to send information about the research project and opt-in forms to the parents/legal guardians of potential students. Parents/legal guardians will be asked to return the opt-in forms to you to give permission to be contacted by the researcher.
2. *Identification of Communication Objectives*: The SLP will be asked to collaborate with researcher to identify specific communication objectives based on the student's IEP (dependent variables) that are unique to the student who will use the iPad and *Speak for Yourself!* app during the implementation period.
3. *Implementation of iPad App*: as described above
4. *Data Collection:* Data collection in the form of a provided data collection sheet regarding progress in therapy with student participating in the study. *(Implementation is technically part of therapy – tracking sheet will be completed at three points during the study and should take approximately 10 minutes per week to fill out).*

What are the possible risks of participating in this study?
There are minimal risks associated with your child's participation in this study. You may feel a loss of time in your child's regularly scheduled therapy if gains in communication are not made as a result of the implemented intervention related to the study.

What are the possible benefits of participating in this study?
There are some possible benefits associated with participating in this study:

- It is anticipated that participants may make gains in functional communication as a result of implemented therapy associated with this study.
- Parents and education teams associated with participants who make gains from using the iPad as a speech-generating device may want to explore obtaining this device or similar speech-generating devices for future implementation with said student.

If you choose to participate in this study, will it cost you anything?
There are no financial costs associated with participating in this study.

Will you receive any compensation for participating in this study?
As a participant, upon completion of the study your child will receive a $50 iTunes gift card. There are no penalties for withdrawing from this study. Participants will receive the $50 iTunes gift card regardless of completion of participation in the study.

What other options are available if you do not want to take part in this study?
You understand that your consent for your child to participate in this research is entirely voluntary, and that your refusal to have your child participate will involve no prejudice, penalty or loss of benefits to which you would otherwise be entitled.

Can you withdraw from this study?
If you consent for your child to participate in this study, you are free to stop your child's participation in the study at any time without prejudice, penalty, or loss of benefits to which you would otherwise be entitled.

How will the confidentiality of your records be protected?
Data will be kept secure via password-protected folders stored on a password-protected external hard-drive. Researchers, along with Rae Sonnenmeier (our graduate research advisor and professor at the University of New Hampshire), will have the passwords to access data. Participants' personal information and corresponding data will be kept anonymous by assigning each with a non-descriptive code. If any password holders are to exit the study prior to completion, new passwords will be assigned. Upon completion of the study, data will be kept for a period of five years. Data will be used for a thesis project, as well as the potential for use in future presentations and publications.

You should understand, however, there are rare instances when the researcher is required to share personally identifiable information (e.g., according to policy, contract, regulation). For example, in response to a complaint about the research, officials at the University of New Hampshire, designees of the sponsor(s), and/or regulatory and oversight government agencies may access research data.

You also should understand that the researcher is required by law to report certain information to government and/or law enforcement officials (e.g., child abuse, threatened violence against self or others, communicable diseases).

Whom to contact if you have questions about this study:
If you have any questions pertaining to the research you can contact Amber Szilagyi (adu223@wildcats.unh.edu) or Kelsey Hall (kst3@wildcats.unh.edu) to discuss them.

If you have questions about your rights as a research subject you can contact Dr. Julie Simpson in UNH Research Integrity Services, 603-862-2003 or Julie.simpson@unh.edu to discuss them.

I,_____ have read the previous information thoroughly and CONSENT/AGREE to my child's participation in this research study.

_____
Child's Name

_____
Printed Name of Parent or Legal Guardian

_____ _____
Signature of Parent or Legal Guardian **Date**

Appendix C

Parent Informational Meeting Script

Once parents/legal guardians of potential child participants have been contacted via the provided consent to contact form and have expressed interest via e-mail or telephone, an information session will be scheduled with each interested parent/legal guardian.
The parent(s)/legal guardian will meet with both researchers (Amber Szilagyi and Kelsey Hall) to discuss the role of the child participant in this study, ask questions and discuss concerns about participation, and review of the informed consent.
This document outlines the information to be discussed regarding Child Participation in the study during the information session:

- Review of inclusion and exclusion criteria
- An overview of the projected research study timeline
- Expectations of child participants
    - Engage use of the iPad with *Speaking for Yourself!* Application during regularly scheduled speech and language therapy sessions at school with the child's speech language pathologist.
    - Use of the iPad with *Speaking for Yourself!* Application will be focused on communication goals defined in the child's Individualized Education Program (IEP).
    - Nothing beyond time spent in weekly scheduled speech and language therapy.
- The Role of the participating speech language pathologist will include:
    - Assisting the primary researcher in determining functional communication goals based on the participating child's Individualized Education Program (IEP)
    - Gathering baseline data related to the identified communication goals
    - Weekly data tracking (via provided data tracking sheets) regarding participant progress on the identified communication goals (in addition to typical data collection during therapy).
- The researcher has the option to offer to explain what the SLP is doing for Kelsey's study if parents are interested.
- Incentives:
    - Parents/legal guardians will receive a $50 Visa gift card in appreciation for their child's participation in this study.
- Review any questions or concerns about the study.
- Review of informed consent
    - What it means to sign this form.
    - Participation is purely voluntary. Parents/legal guardians or child participants may opt out at any time with no penalty.
- The researcher will caution parents/legal guardians who elect to have their child participate in the study to not purchase the *Speak For Yourself!* app while the child is in the study as this will impact the validity of the results.

- The parents/legal guardians will have up to 1 week from the informational meeting to decide whether or not they wish for their child to participate in the study.

If a parent/legal guardian gives consent for their child to participate in the study, the primary researcher will be in contact to begin the research proc

Appendix D

Student Participant Assent

Assent Choice Board

As shown in Figure H1, the researcher created a choice board using Boardmaker® software. SLPs used this choice board as part of Student Assent Protocol.

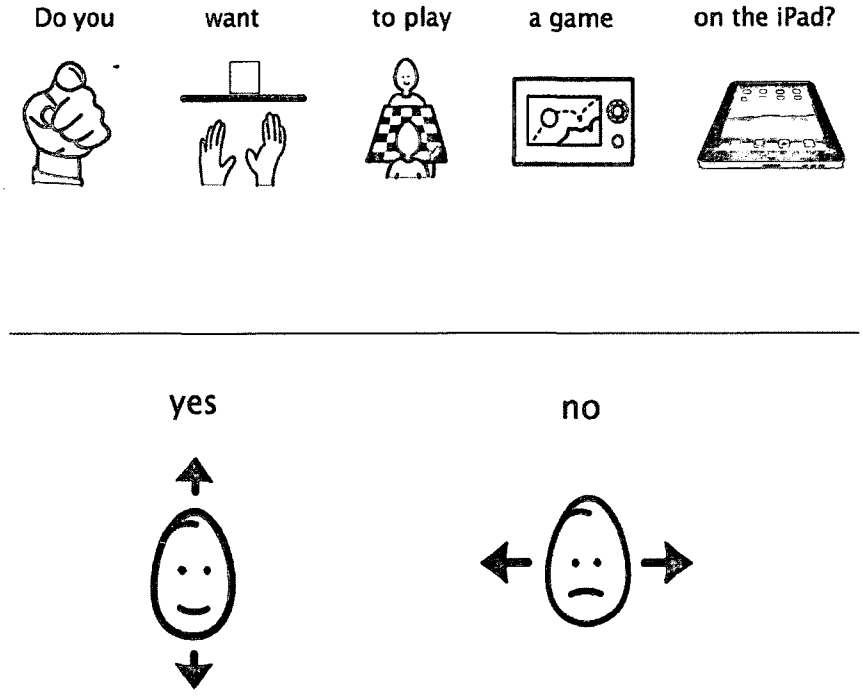

Figure H1. Student Assent Choice Board was used as part of protocol when obtaining assent prior to each introduction of the iPad.

Student Assent Protocol

The SLP will obtain assent before using the iPad during each speech therapy session. The SLP will use a combination of verbal and visual supports (choice board) to ask the students:

"Do you want to play a game on the iPad?"

The students will then be given time to respond. Depending on the child's ability he or she will be asked to make a mark (circle, "x-out", etc.) to indicate their choice.

If the student's behavior or communication suggests that he/she would like to stop using the iPad, the SLP will be instructed to discontinue use of the iPad during the session. If the student's behavior or communication suggests that he/she would be interested in re-engaging use of the iPad, the SLP will repeat the assent process.

Appendix E

Data Collection Sheet

Student: **Date: ____/____/_____** ☐ **Baseline** ☐ **Mid-Intervention** ☐ **Post-Intervention**	**Degree of Attainment**				
	-2 **Much Less than Expected**	**-1** **Somewhat less than expected**	**0** **Expected Level of Outcome**	**1** **Somewhat more than Expected**	**2** **Much more than Expected**
Dependent Variables					
DV #1:					
Comments:					
DV#2:					
Comments:					
DV#3:					
Comments:					

Appendix F

Weekly Monitoring Sheet

SLP: _____ **Week #** _____ **Student:** _____ Dependent Variables (IEP Goals)	Goal Attainment Scaling (GAS)* Use the scale to describe this week's progress:					Data Collection/Comments:
DV #1:						
Session Objective (Expected Level of Outcome):	-2	-1	0	1	2	
DV #2:						
Session Objective (Expected Level of Outcome):	-2	-1	0	1	2	
DV #3:						
Session Objective (Expected Level of Outcome):	-2	-1	0	1	2	

Appendix G

Example of GAS Procedures

Goal Attainment Scaling

GOAL ATTAINMENT SCALING

PROCEDURE AND ILLUSTRATIONS

Goal attainment scaling (GAS) is a system for assessing progress children and youth with Autism Spectrum Disorders (ASD) make on individual goals across a specified time period. These goals are drawn from Individualized Education Programs (IEPs) or Individualized Family Service Plans (IFSPs) and established by teachers, related services professionals, family members, and in some cases the individual with ASD. In this process, staff from the National Professional Development Center on ASD (NPDC-ASD) collaborate with teachers/practitioners to identify three IEP/IFSP goals that have the highest priority for the individual with ASD and establish a five-point scale to measure child/student progress. An illustration of the five-point scale is found in the table below.

Table 1. Example Goal Attainment Scale

Level of Attainment	Goal 1: Uses questions	Goal 2: Completes work assigned independently	Goal 3: Engages in playful social interaction with peers during play period
Much less than expected -2	When given a model and prompted, will ask questions of adults.	Requires teacher prompts on at least 75% of the tasks assigned for independent work time.	Primarily is alone, unengaged, and inattentive to peers during recess.
Somewhat less than expected -1	When prompted, will ask questions of adults during 50% of the opportunities presented.	Completes 50% of work assigned during specified work time with appropriate supports.	Plays alone in close proximity to peers and watches their play for 50% of play period during recess.
Expected level of outcome 0	Independently asks questions to obtain information from adult in classroom during 80% of opportunities presented.	Independently completes work assigned during specified independent work time with appropriate supports for 80% of work sessions.	During recess, plays with at least one peer for 50% of the play period.
Somewhat more than expected +1	Independently uses questions with at least two different adults in classroom during 60% of opportunities presented.	Independently completes work and puts away materials after work task is completed for 80% of work sessions.	During recess, routinely plays with at least one peer for at least 50% of the play session.
Much more than expected +2	Independently asks questions of adults in classroom and in at least one other content during 100% of opportunities.	Independently completes tasks, puts materials away, and tells teacher he/she is done for 100% of work sessions.	During recess, routinely plays with two peers for at least 50% of the play session.
Comments			

(from Cardillo & Choate, 1994)

Procedure for Developing a Goal Attainment Scale for Children and Youth with ASD

1. Select three IEP/IFSP goals that have high priority for the child/student with ASD. These goals should be scaleable, in that a continuum of outcomes is identifiable. An example of a scaleable goal is: "Participant uses a question to obtain information in different contexts." Dichotomous goals which are answered as either "yes" or "no" should not be used. An example of a dichotomous goal is: "Learner makes an appointment with a vocational rehabilitation counselor."

2. Assign each goal an abbreviated title and in accompanying documentation, cross reference the actual goal from the IEP or IFSP. For example, a longer behavioral objective such as, "In the classroom, the learner will independently ask questions to obtain information 8 out of 10 opportunities," could be modified to the title, "Uses questions."

3. Specify the levels of attainment according to the numbering on the scale, which ranges from -2 to +2 with 0 being the expected outcome of the goal. The GAS will be completed in the fall and spring of the academic year. Specific information related to the scoring of each goal is described below.
    a. The goal from the IEP or IFSP is the expected outcome for the objective which appears at the middle or "0" point on the continuum of outcomes. In the example above, the "0" on the continuum is that the learner asks questions 80% of the time or 8 out of 10 opportunities. The baseline or initial functioning level of the learner for a particular goal could be the -2 designation (much less than expected) on the continuum of Goal Attainment Guide.
    b. Progress that is slightly below or slightly above the expected outcomes should be specified as -1 (somewhat less than expected) or +1 (somewhat more than expected). In the example above, the -1 on the continuum might be that the learner asks questions only 6 out of 10 opportunities. The + 1 on the continuum might be that the learner asks questions 8 out of 10 opportunities.
    c. Progress that is much less or much more than expected should be designated for -2 (much less than expected) or +2 (much more than expected). In our example, the +2 on the continuum might be that the learner asks questions every time the opportunity arises or 10 out of 10 times.

4. Each of these scaling steps should be completed for the three IFSP/IEP goals. To complete this process, NPDC-ASD staff will meet with teachers/practitioners to prioritize goals and explain the need to predict a continuum of outcomes for individual children and youth with ASD.

5. Goal Attainment Scaling will be completed by NPDC staff and teachers/practitioners in the fall and again in the spring to assess student/child progress on expected outcomes for the three selected goals.

References

Cardillo, J. E., & Choate, R. O. (1994). Illustrations of goal setting. In T. Kiresuk, A. Smith, & J. Cardillo, (Eds.). *Goal attainment scaling: Applications, theory, and measurement* (pp. 15-37). Hillsdale, NJ: Lawrence Erlbaum Associates.

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IRB #: 5487
Study: Emerging Technology Part 2: Efficacy of Using iPads as Speech-Generating Devices with Students Who Have Complex Communication Needs in Academic Settings
Review Level: Full
Approval Expiration Date: 14-Jun-2014

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) has reviewed and approved your request for time extension for this study. Approval for this study expires on the date indicated above. At the end of the approval period you will be asked to submit a report with regard to the involvement of human subjects. If your study is still active, you may apply for extension of IRB approval through this office.

Researchers who conduct studies involving human subjects have responsibilities as outlined in the document, *Responsibilities of Directors of Research Studies Involving Human Subjects.* This document is available at http://unh.edu/research/irb-application-resources or from me.

If you have questions or concerns about your study or this approval, please feel free to contact me at 603-862-2003 or Julie.simpson@unh.edu. Please refer to the IRB # above in all correspondence related to this study. The IRB wishes you success with your research.

For the IRB,

Julie F. Simpson
Director

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